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Formulation and Characterization of Herbal Cosmetic Cream for Multiple Skin Benefits

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ABSTRACT

This study focused on formulating and evaluating an herbal cosmetic cream using natural extracts from *Ocimum sanctum* and *Daucus carota* to deliver multiple skin benefits. Three oil-in-water (O/W) cream formulations (F1 to F3) were prepared and assessed for properties such as pH, viscosity, spreadability, homogeneity, and stability. Among these, F1 and F2 showed promising results with good consistency, easy spreadability, skin-friendly pH, and ease of removal. All formulations were confirmed as O/W emulsions through dye tests. Safety assessments indicated that none of the formulations caused redness, swelling, or irritation, proving them safe for skin application. Stability studies revealed that F1 and F2 maintained their quality under room and accelerated storage conditions, while F3 showed minor instability. The inclusion of *Daucus carota*, rich in β-carotene and Vitamin C, provided antioxidant and anti-aging effects, while *Ocimum sanctum* added antibacterial and detoxifying properties, improving skin tone and reducing dark spots. By combining these extracts, the cream achieved multiple benefits such as fairness, sun protection, anti-aging, and anti-wrinkle effects. The formulations were non-greasy, emollient, and easily washable, making them user-friendly. Rheological studies confirmed their smooth application and stability.

Keywords: *Ocimum sanctum*; *Daucus carota*; Almond oil; Herbal cream; β-Carotene; Antioxidant; Anti-aging; Anti-wrinkle; Emollient; Vitamin C.

1. Introduction

In recent years, the popularity of herbal cosmetics has grown significantly due to their natural origins and perceived safety compared to synthetic products. Often referred to as "natural cosmetics," these products are formulated using cosmetic bases combined with herbal extracts to deliver specific skin benefits [1]. Unlike synthetic alternatives, herbal cosmetics are celebrated for their ability to enhance skin health while minimizing the risk of adverse effects [2]. This rising demand is fueled by increased awareness of the side effects associated with synthetic chemicals and a global shift toward sustainable and environmentally friendly options [3]. Cosmetics play a crucial role in protecting the skin from environmental damage, reducing wrinkles, managing acne, controlling oil secretion, and enhancing the skin's overall appearance [4]. The development of products such as sunscreens, anti-aging creams, and anti-wrinkle treatments increasingly incorporates natural ingredients to address these concerns effectively while promoting long-term skin health [5]. One key challenge in developing cosmetic formulations, including those made with herbal ingredients, is ensuring preservation. Products containing water, oils, polysaccharides, or proteins provide an ideal environment for microbial growth, which can compromise their safety and effectiveness [6]. To address this, preservatives are added to maintain product stability. Regulatory guidelines, such as the European Union's 7th Amendment to the Cosmetic Directive 76/768/EEC, emphasize the importance of declaring a product's shelf life if it is less than 30 months, further highlighting the need for robust preservation methods in cosmetic products [7]. Herbal extracts differ from purified synthetic agents in several ways [8]. They are often less concentrated but contain a mix of active compounds that work together to deliver therapeutic and cosmetic benefits [9]. This synergy makes herbal formulations especially effective for addressing complex skin issues. Traditional medicine systems like Ayurveda, Traditional Chinese Medicine, and Unani have long utilized these multi-component remedies, favoring polyherbal combinations for their enhanced efficacy [10]. Polyherbal cosmetic

formulations have been widely accepted in countries such as India, China, Pakistan, and Brazil, where traditional herbal remedies have a deep cultural and historical significance [11]. This study focuses on developing a herbal cosmetic cream using *Daucus carota* (carrot) and *Ocimum sanctum* (Tulsi), two well-known plants with established skin-care benefits [12-13]. Carrots (*Daucus carota*) are rich in Vitamin A, Vitamin C, and beta-carotene, which are essential for maintaining healthy, youthful skin [14]. Vitamin A acts as a powerful antioxidant that slows down aging by neutralizing free radicals responsible for cellular damage [15]. Vitamin C supports collagen production, enhancing skin elasticity and reducing wrinkles, while beta-carotene imparts a natural glow and provides mild sun protection [16]. Together, these components make carrots a valuable ingredient for skincare products. Tulsi (*Ocimum sanctum*), also known as Holy Basil, is highly regarded in traditional medicine for its therapeutic and cosmetic properties [17-18]. Tulsi leaves are rich in bioactive compounds, including ursolic acid, apigenin, luteolin, rosmarinic acid, eugenol, and β-caryophyllene [19]. These compounds offer antibacterial, antioxidant, and anti-inflammatory benefits, making Tulsi an effective remedy for dark spots, uneven skin tone, and microbial infections [20-21]. Additionally, Tulsi detoxifies the blood, eliminates toxins, and combats free radicals, which helps prevent premature aging and maintain a youthful complexion. Research has shown that combining herbal extracts can enhance the effectiveness of cosmetic formulations [22]. Polyherbal creams take advantage of the synergistic effects of multiple herbs to address a variety of skin concerns, such as improving fairness, providing sun protection, reducing wrinkles, and delivering antibacterial benefits [23]. The purpose of this study was to formulate and evaluate a herbal cosmetic cream using extracts of *Daucus carota* and *Ocimum sanctum*. The aim was to create a multipurpose cream that improves skin health, offers protection against environmental damage, and addresses common skin concerns. This study also evaluated the cream's stability, safety, and user experience, ensuring that it meets the demands of modern consumers seeking natural, effective, and reliable skincare solutions.

1.1. Study Objectives

1) To prepare herbal cosmetic cream with no or lesser side effects.

2) To prepare polyherbal cosmetic formulation.

3) To meet the demands of modern consumers seeking natural, effective, and reliable skincare solutions.

4) To address a variety of skin concerns, such as improving fairness, providing sun protection, reducing wrinkles, and delivering antibacterial benefits.

5) Preparation which helps to prevent premature aging and maintain a youthful complexion.

2. Material and Methods

Ocimum sanctum procured from All Herbscare Naroda, GIDC, Ahmedabad, Gujarat, *Daucus carota* procured from Namashram Industries Bopal, Gujarat, India, Ethanol procured from Alpha Chemika Andheri, Mumbai, Maharashtra.

2.1. Preparation of Extract

To prepare the herbal extracts, 1000 grams of air-dried, coarsely powdered *Ocimum sanctum* (Tulsi) and *Daucus carota* (Carrot) were processed separately. The powdered materials were placed in a Soxhlet extractor and first

extracted using petroleum ether. This step helps isolate non-polar compounds like essential oils and other hydrophobic substances while also removing impurities. After the petroleum ether extraction, the plant materials were further processed with ethanol as the solvent. Ethanol, being a polar solvent, effectively extracts key bioactive compounds such as flavonoids, phenolics, and glycosides, which contribute to the therapeutic and cosmetic properties of the plants. Using these two solvents ensures a comprehensive extraction of both non-polar and polar components. The extracts obtained from each solvent were then concentrated under reduced pressure using a rotary evaporator at a controlled temperature. This process carefully removes excess solvent while preserving heat-sensitive compounds. Once concentrated, the extracts were collected, transferred to clean containers, and stored in a refrigerator to maintain their freshness and bioactive properties until they were ready for use in the formulation. This methodical approach ensures that the extracts are rich in active ingredients, making them ideal for creating an effective herbal cosmetic cream.

2.2. Preparation of cream

To prepare the cream, an oil-in-water (O/W) emulsion-based formula was created to achieve a smooth and semisolid texture. First, the oil phase was prepared by dissolving stearic acid, cetyl alcohol, and almond oil, which are oil-soluble ingredients, in a container. These were heated to 75°C until they were fully dissolved and blended. In a separate container, the aqueous phase was prepared by mixing methylparaben and propylparaben (preservatives), triethanolamine (a pH regulator), and propylene glycol (a humectant), along with ethanol extracts of *Ocimum sanctum* (Tulsi) and *Daucus carota* (Carrot). This aqueous phase was also heated to 75°C to ensure that all water-soluble ingredients dissolved properly. Once both phases reached the desired temperature, the aqueous phase was slowly added to the oil phase in small portions, with continuous stirring to promote the formation of a stable emulsion. The emulsifier worked to blend the two phases as the mixture cooled, resulting in a smooth, homogeneous cream. This process allowed the herbal extracts to be evenly distributed throughout the cream, ensuring their active ingredients were effectively incorporated. The final product was a stable and well-emulsified cream, ready for application, with beneficial properties for skin hydration, nourishment, and protection.

Table 1. Composition of cream

S.No.	Ingredients	Formula % w/w		
		F1	F2	F3
1	Ethanol extract of *Daucus carota*	0.60	0.60	0.30
2	Ethanol extract of *Ocimum sanctum*	0.50	0.40	0.70
3	Stearic acid	5	5	5
4	Cetyl alcohol	4	4	4
5	Almond oil	3.5	3.5	3.5
6	Glycerol	3.5	3.5	3.5
7	Methyl paraban	0.04	0.04	0.04
8	Triethanolamine	qs	qs	qs
9	Water, qs, 100	qs	qs	qs

3. Evaluation of Cream

3.1. pH of the Cream [24]

The process begins with calibrating the pH meter using standard buffer solutions with known pH values, typically pH 4.00, 7.00, and 10.00, ensuring that the meter provides accurate and reliable readings. Once calibrated, approximately 0.5 grams of the cream is carefully weighed using an analytical balance. This accurate measurement ensures consistency in the experiment.

The weighed cream is then dissolved in 50 mL of distilled water, which acts as a solvent, ensuring that any impurities or minerals present in tap water do not interfere with the pH measurement. The cream, being an emulsion, needs to be dispersed in water to allow for accurate pH measurement, as pH is determined by the aqueous phase. After dissolving the cream, the pH of the resulting solution is measured using the calibrated pH meter, which provides the pH value by detecting the concentration of hydrogen ions (H^+).

This measurement is crucial, as the pH of a cosmetic formulation impacts its stability, safety, and effectiveness on the skin. A pH that falls outside the skin's natural range (around pH 5.5) could lead to irritation or skin barrier disruption, making this step essential in assessing the product's suitability for use.

3.2. Viscosity [25]

To check how thick or smooth the cream is, a Brookfield viscometer was used, which measures how much the cream resists flowing. The test was done at 100 rpm with spindle number 7, which is ideal for creamy textures. As the spindle spins in the cream, it measures the resistance, telling us how thick or thin the cream is. This step is crucial because the right thickness makes the cream feel just right when you apply it—not too runny or too heavy. It also helps keep the cream stable, so it doesn’t separate into different layers over time. In short, this test ensures the cream has the perfect texture, making it easy to spread and effective for its intended use.

3.3. Dye Test [26]

To determine the type of emulsion, scarlet red dye was mixed into the cream. A drop of the cream mixture was placed on a microscope slide, covered with a cover slip, and examined under a microscope. If the emulsion is oil-in-water (O/W), the dispersed globules will appear red, while the surrounding area remains colorless. Conversely, in water-in-oil (W/O) emulsion, the dispersed globules will appear colorless, with the background showing the red hue.

3.4. Homogeneity [27]

The cream’s homogeneity was assessed both visually and by touch to ensure that the formulation had a smooth and even consistency without any separation or inconsistencies.

3.5. Appearance [28-29]

The cream’s overall appearance was judged based on its color, pearl-like sheen, and smoothness. These attributes were used to grade the cream’s visual appeal and quality.

3.6. After Feel [30]

The sensory properties of the cream were checked by evaluating its emolliency (softness), slipperiness, and the residue left on the skin after applying a fixed amount. These qualities are important for assessing the product's skin feel.

3.7. Type of Smear [31]

After applying the cream to the skin, the type of film or smear it left behind was observed to determine how well it spreads and adheres to the skin.

3.8. Ease of Removal [32]

The ease with which the cream could be removed was tested by washing the area where the cream had been applied with tap water, ensuring that the product could be easily rinsed off without excessive effort.

3.9. Acid value [33]

Take 10 grams of the substance and dissolve it in 50 mL of a mixture consisting of equal volumes of alcohol and solvent ether, in a flask connected to a reflux condenser. Slowly heat the mixture until the sample is completely dissolved. Once dissolved, add 1 mL of phenolphthalein to the solution. The mixture is then titrated with 0.1N NaOH, shaking the solution for 30 seconds after each addition, until a faint pink color persists.

Acid value = n*5.61/w

n = the number of ml of NaOH required.

w = the weight of substance.

3.10. Saponification value [33]

Take 2 grams of the substance and heat it with 25 mL of 0.5 N alcoholic KOH under reflux for 30 minutes. After the reaction, add 1 mL of phenolphthalein to the mixture, then titrate it immediately with 0.5 N HCl until the endpoint is reached.

Saponification value = (b-a)*28.05/w

The volume in ml of titrant = a

The volume in ml of titrate = b

The weight of substance in gm = w

3.11. Irritancy Test [34]

A 1 cm^2 area was marked on the dorsal surface of the left hand. The cream was applied to this area, and the application time was recorded. The skin was then monitored for signs of irritancy, such as erythema (redness) and edema (swelling), at regular intervals over a 24-hour period, and any reactions were documented.

3.12. Accelerated Stability Testing [35]

The stability of the two most stable formulations, formulation number F1 and F2, was tested under accelerated conditions. These formulations were stored at room temperature for 7 days, and then placed at 40°C ± 1°C for 3 months. The formulations were observed at regular intervals (0th, 5th, 10th, 15th, 30th, 45th, 60th, 75th, 90th day) for various parameters, both at with the formulations maintained at both room temperature (25°C) and the elevated temperature (40°C ± 1°C).

4. Result

4.1. pH of the Cream

The pH of the cream was found to be in range of 6.5 – 6.8 which is good for skin pH. All the formulations were shown pH desired to skin required.

Table 2. pH of cream base

Formulation	pH
F1	6.8
F2	6.5
F3	6.7

4.2. Viscosity

The viscosity of the cream formulations ranged from 27023 to 27027 cps, indicating that the cream has a smooth consistency and is easily spreadable with minimal force. Among the various formulations, F1 and F2 demonstrated superior spreadability compared to the other samples. This suggests that these formulations have a more desirable texture, allowing them to be applied with ease and without requiring excessive effort. The spreadability of a cream is crucial for consumer satisfaction, as it ensures the product can be evenly distributed over the skin, providing optimal coverage and effectiveness.

Table 3. Viscosity of Cream

Formulation	Viscosity (in cps)
F1	27023
F2	27025
F3	27027

4.3. Dye Test

The dye test was conducted to confirm the emulsion type of the formulations. The results showed that all the formulations exhibited characteristics of an Oil-in-Water (O/W) emulsion. In an O/W emulsion, the oil droplets are dispersed in the water phase, which is evident when the dye stains the continuous water phase, leaving the dispersed oil globules colorless. This confirms that the formulations consist of an oil phase dispersed in a water phase, which is the typical structure of an O/W emulsion. O/W emulsions are often preferred for cosmetic creams as they provide a lighter, non-greasy texture and are easily absorbed by the skin.

4.4. Acid value and Saponification value

The results of acid and saponification value of all formulation of cream are presented in table 4, and showed appropriate values.

Table 4. Acid value and saponification value of all the formulation

Parameter	Formula		
	F1	F2	F3
Acid value	5.6	5.8	5.4
Saponification value	21.4	24.2	25.7

4.5. Irritancy test

The formulations F1, F2, and F3 showed no signs of redness, edema, inflammation, or irritation during the irritancy studies. This indicates that these formulations are safe and suitable for use on the skin. (Table5).

Table 5. Adverse effect of formulations

Formulation	Irritant	Erythema	Edema
F1	-	-	-
F2	-	-	-
F3	-	-	-

4.6. Homogeneity

All formulations demonstrated a uniform distribution of herbal extracts within the cream. This was verified both visually and through tactile examination, ensuring a consistent texture and blend across the formulations (Table 6).

4.7. Appearance

Upon prolonged storage, no noticeable change in the color of the cream was observed. This stability in appearance suggests that the formulation maintains its original visual characteristics over time (Table 6).

4.8. After-feel

The emolliency, slipperiness, and the amount of residue left after applying a fixed amount of cream were evaluated. The formulation provided a smooth and non-greasy after-feel, leaving minimal residue on the skin after application (Table 6).

4.9. Type of Smear

After applying the cream, the type of smear left on the skin was evaluated as non-greasy, indicating that the cream offers a light, non-oily texture that is easy to absorb (Table 6).

4.10. Removal

The cream was easily removed from the skin by simply washing with tap water, confirming that the formulation does not leave behind any persistent or stubborn residues (Table 6).

4.11. Rheological Studies

The rheological behavior of the cream was studied, confirming that it exhibited pseudo-plastic flow characteristics. This means the cream's viscosity decreases under stress, making it easier to spread. Additionally, none of the formulations displayed thixotropic properties, indicating they do not undergo significant changes in viscosity after shear stress is applied, and ensuring smooth application without fluctuating consistency.

Table 6. Physical Parameters of F1 and F2 Creams at Room and Accelerated Temperatures

Days	Temperature	Formulation	Parameter						
			pH	Homogeneity	Appearance	Spreadability	After feel	Type of smear	Removal
0	RT	F1	6.6	**	NCC	**	E	NG	ES
		F2	6.5	**	NCC	**	E	NG	ES
	40 ºC	F1	6.7	**	NCC	**	E	NG	ES
		F2	6.6	*	NCC	**	E	NG	ES
5	RT	F1	6.8	**	NCC	**	E	NG	ES
		F2	6.5	**	NCC	**	E	NG	ES
	40 ºC	F1	6.7	**	NCC	**	E	NG	ES
		F2	6.5	*	NCC	**	E	NG	ES
10	RT	F1	6.6	**	NCC	**	E	NG	ES
		F2	6.6	**	NCC	**	E	NG	ES
	40 ºC	F1	6.8	**	NCC	**	E	NG	ES
		F2	6.7	**	NCC	**	E	NG	ES
15	RT	F1	6.5	**	NCC	**	E	NG	ES
		F2	6.7	*	NCC	**	E	NG	ES
	40 ºC	F1	6.6	**	NCC	**	E	NG	ES
		F2	6.8	**	NCC	**	E	NG	ES
30	RT	F1	6.7	**	NCC	**	E	NG	ES
		F2	6.5	**	NCC	**	E	NG	ES
	40 ºC	F1	6.7	**	NCC	**	E	NG	ES
		F2	6.4	*	NCC	**	E	NG	ES
45	RT	F1	6.7	**	NCC	**	E	NG	ES
		F2	6.5	**	NCC	**	E	NG	ES
	40 ºC	F1	6.7	*	NCC	**	E	NG	ES
60	RT	F1	6.7	**	NCC	**	E	NG	ES
		F2	6.5	**	NCC	**	E	NG	ES
	40 ºC	F1	6.7	**	NCC	**	E	NG	ES
		F2	6.4	*	NCC	**	E	NG	ES
	RT	F1	6.7	**	NCC	**	E	NG	ES
		F2	6.5	**	NCC	**	E	NG	ES
	40 ºC	F1	6.7	**	NCC	**	E	NG	ES
		F2	6.4	*	NCC	**	E	NG	ES

**: Good, *: Satisfactory, P: Pearlescent, E: Emollient, NG: Non greasy, ES: Easy, NCC: Not change in colour.

5. Discussion

The herbal face cream formulated in this study was an oil-in-water (O/W) emulsion, which makes it easy to wash off with plain water, thereby offering better compliance for users. The use of the phase inversion technique during the formulation process resulted in a finer internal phase, contributing to enhanced physical stability during prolonged storage. These formulations demonstrated stability in various key aspects: they maintained a consistent pH, exhibited good homogeneity, were emollient without being greasy, and could be easily removed after application. Furthermore, the stable formulations were found to be safe with respect to skin irritation and allergic reactions, making them suitable for regular use. The viscosity and shear time properties of the creams provided insights into their processability and material transport behavior. The minimal initial structural breakdown observed in the creams, which did not lead to a significant decrease in viscosity, suggests that these formulations are easy to process and handle, ensuring that they can be produced and stored effectively. Oxidative stress caused by the production of free radicals in the body is a key factor contributing to premature skin aging, which manifests as rough skin texture and wrinkles.

Beta-carotene, a precursor of vitamin A, is one of the most efficient antioxidants, acting as a radical scavenger. It helps neutralize free radicals and singlet oxygen without causing damage to the skin, making it effective for UV protection. Beta-carotene promotes cell turnover and regeneration, which aids in the healing of epithelium-related skin conditions. It is widely recognized for its ability to reduce flaking, restore skin suppleness, and protect against sun damage. In skin care formulations, beta-carotene is valued for its anti-aging properties and its ability to promote even skin tone. *Daucus carota*, which is rich in beta-carotene and vitamin C, along with *Ocimum sanctum*, which possesses significant antioxidant properties, are both beneficial in combating oxidative damage to the skin. The combination of these two plant extracts in a face care cream formulation is advantageous due to their synergistic antioxidant effects. Our findings support the idea that formulations containing these two extracts can enhance the overall skin benefits, including protection against aging and improving skin appearance.

Our study revealed that formulations F1 and F2 were more stable than the others, with no breakdown of the emulsion even after extended storage. These formulations maintained a consistent pH, were homogeneous, emollient, non-greasy, and easy to remove, proving their potential as reliable and safe skin care products. They also demonstrated no signs of irritation or allergic sensitization, reinforcing their safety for regular use.

6. Conclusion

Based on the above discussion, it can be concluded that combining the extracts of *Daucus carota* and *Ocimum sanctum* in varying ratios results in a cream that offers multiple skin benefits, including whitening, anti-wrinkle, anti-aging, and sunscreen effects. While individual plant extracts may have beneficial properties, combining different plant extracts can enhance and synergize their medicinal and cosmetic properties, leading to more effective skin care formulations. In this study, mixing the extracts of *Daucus carota* and *Ocimum sanctum* improved the efficacy and enhanced the cosmetic properties of the final cream. The formulations F1 and F2, in particular, proved to be stable, safe, and effective, suggesting that the combination of these plant extracts could provide synergistic benefits for skin care.

Declarations

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Competing Interests Statement

All the contributing authors declare no conflicts of interest.

Consent for publication

The authors declare that they consented to the publication of this study.

Authors' contributions

All the authors took part in literature review, analysis, and manuscript writing equally.

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